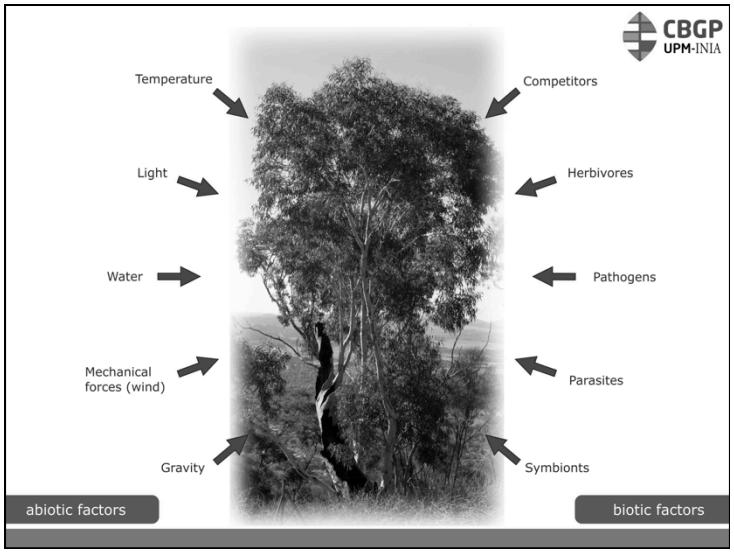
# Auxin - oxylipin crosstalk in stress responses of plant roots

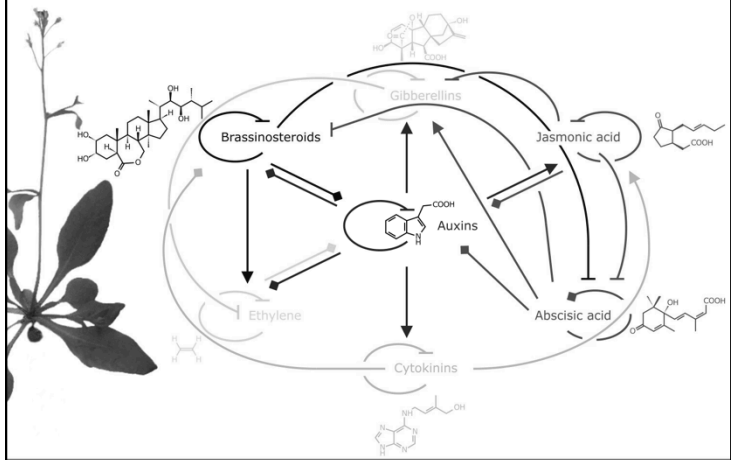
CONGRESS OF THE
SOCIEDAD ESPAÑOLA DE BIOQUÍMICA Y BIOLOGÍA MOLECULAR

Barcelona, 07. September 2011

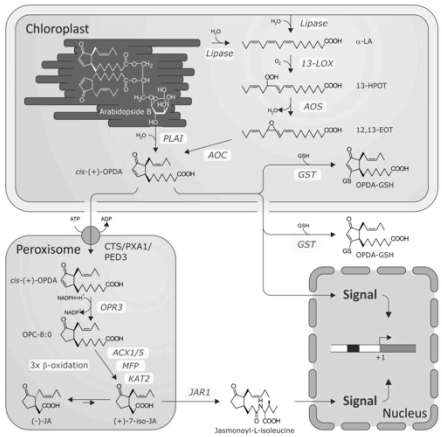
STEPHAN POLLMANN




Plants use a complex hormone-based network to regulate their growth and development

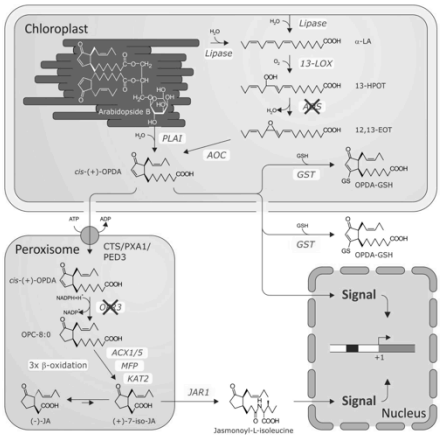



The Vick and Zimmerman pathway of jasmonic acid biosynthesis




Böttcher and Pollmann, *FEBS J.* (2009)

## The *aos*/*opr3* double mutant is a valuable tool for the uncoupled analysis of OPDA- and JA-triggered responses

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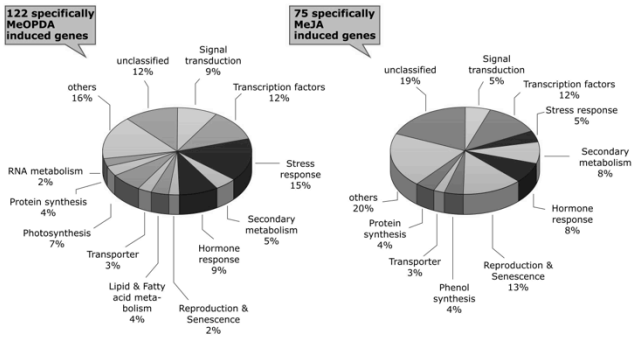
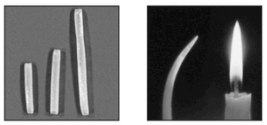



## Indole-3-acetic acid and Jasmonic acid - two on the first sight antagonistically acting signaling molecules

### Auxins

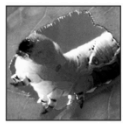
- Growth promoting
- Apical dominance
- Tropisms
- Shoot elongation
- Induction of cambial cell divison activity
- Formation of lateral- and adventitious roots
- Fruit development

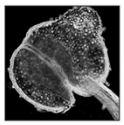




### Jasmonates

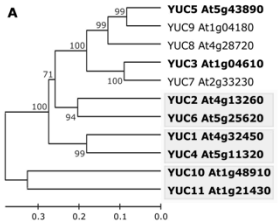
- Growth inhibiting
- Senescence promoting
- Plant defense
- Male fertility
- Flower development
- Mechanotransduction
- Tuber formation

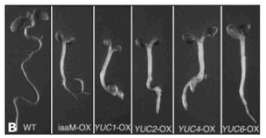


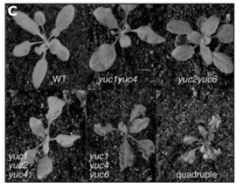


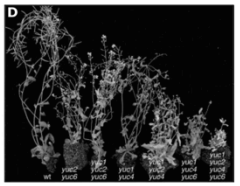
Pollmann et al., *Plant Biol.* (2006); Böttcher & Pollmann, *FEBS J.* (2009); Lehmann et al., *Eur. J. Cell Biol.* (2010)

## YUCCA flavin-containing monooxygenase-like proteins are recognized as key enzymes in auxin synthesis, catalyzing a rate-limiting reaction step




Photos courtesy of Youfa Cheng and Yunde Zhao

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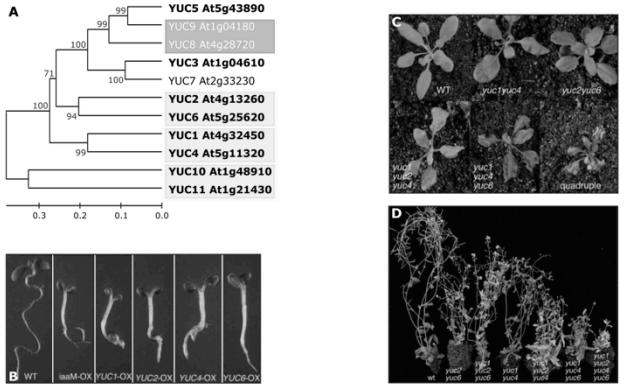
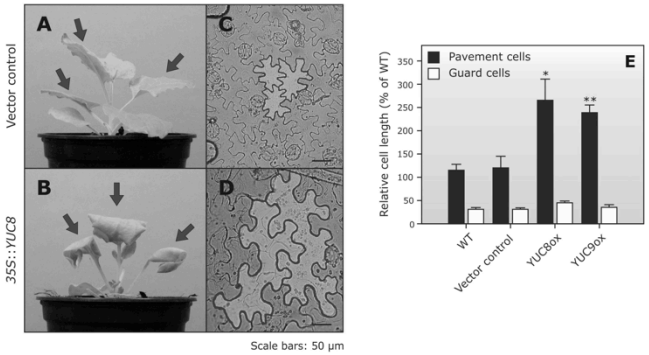
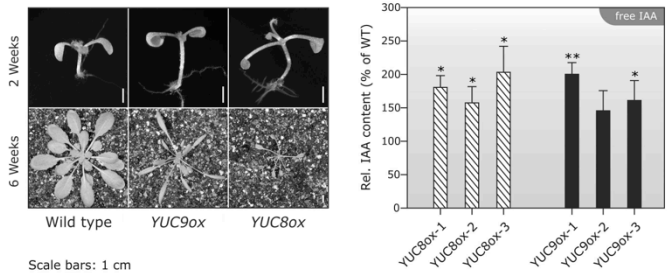



Photos courtesy of Youfa Cheng and Yunde Zhao

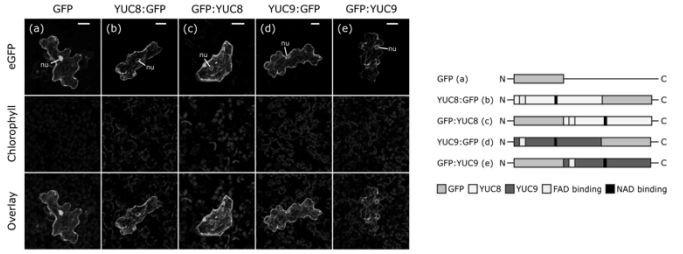
Transient expression of *35S::YUC8* and *35S::YUC9* after introduction into *Nicotiana benthamiana* leaves



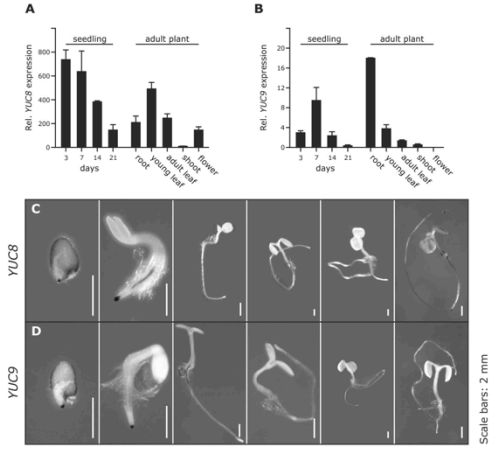

Constitutive and stable overexpression of *35S::YUC8* and *35S::YUC9* in *Arabidopsis thaliana*



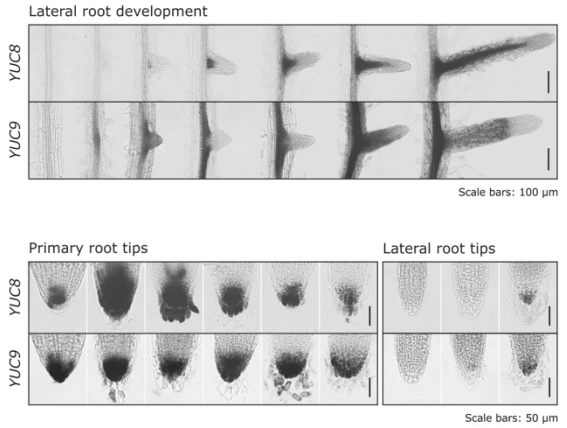

YUC8- and YUC9-GFP fusion proteins are exclusively located to the cytoplasm



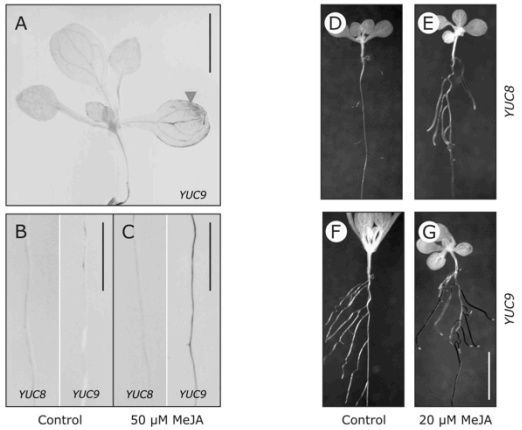
The *YUC8* and *YUC9* genes are differentially expressed during development and show reasonable expression in roots



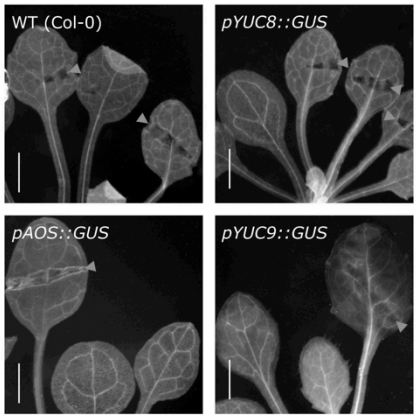

YUC8 and YUC9 are presumably not involved in lateral root initiation, but rather contribute to lateral root out-growth



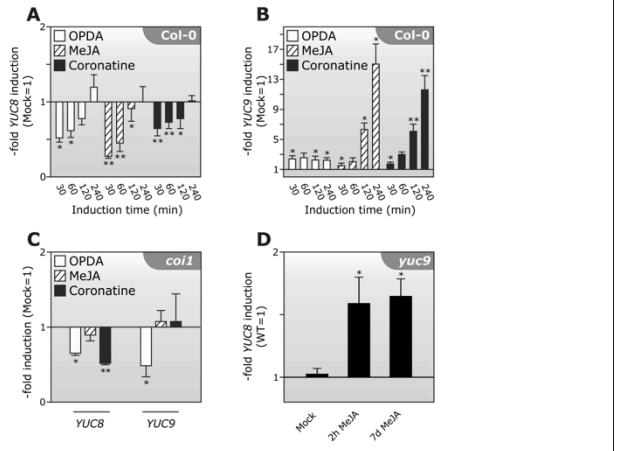

The exogenous application of methyl jasmonate (MeJA) induces the expression of *YUC8* and *YUC9*



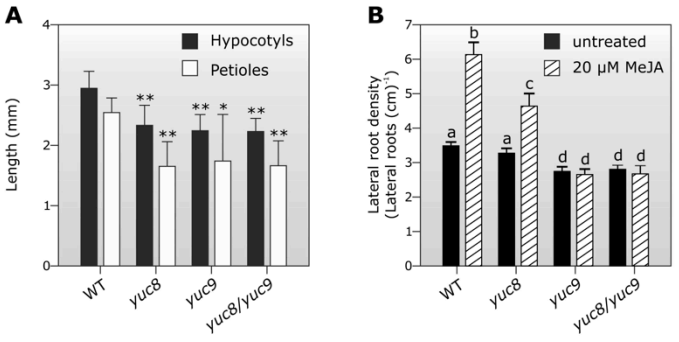

Wound-induced production of endogenous jasmonate is sufficient to induce the expression of the *YUC9* gene



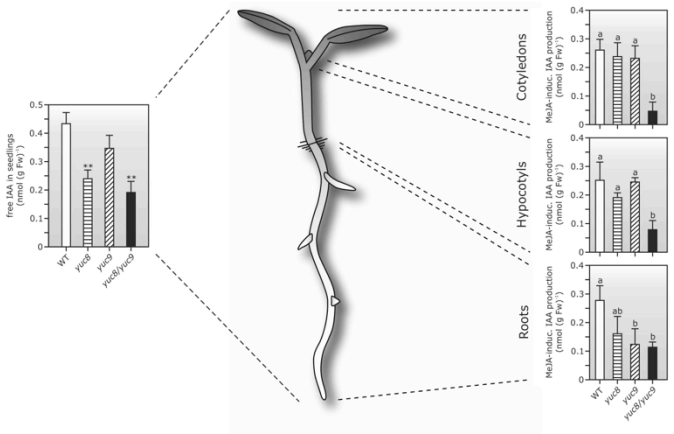
qRT-PCR analyses corroborate the differential impact of oxylipins on *YUC8* and *YUC9* gene expression



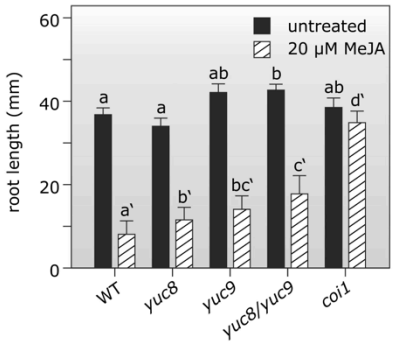

*yuc8*- and *yuc9*-mutants can be distingushed from wild type as they have shorter hypocotyls and petioles as well as a reduced lateral root density

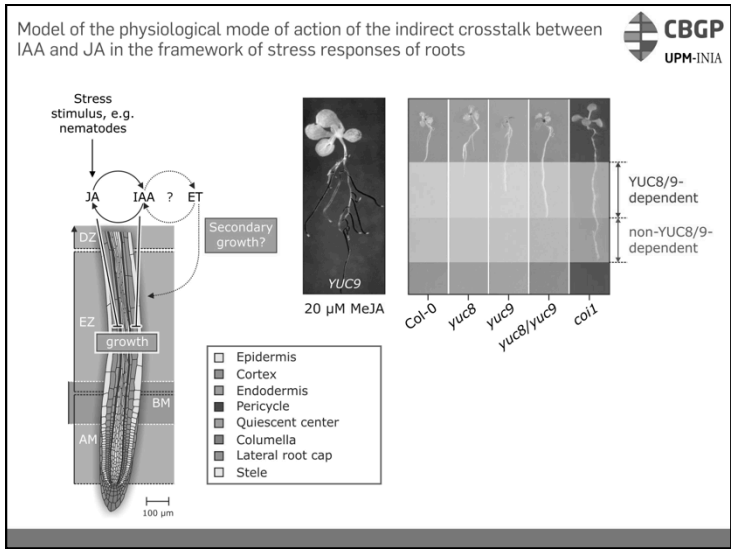


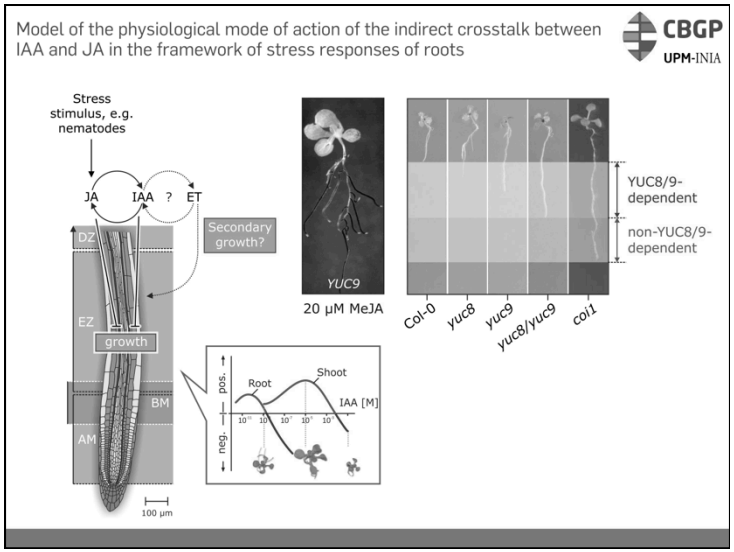

Relative to wild type, *yuc8*- and *yuc9*-mutants have reducd IAA contents and display reduced IAA production in response to MeJA treatment




*yuc8*- and *yuc9*-mutants are characterized by a reduced responsiveness to MeJA treatment




Model of the physiological mode of action of the indirect crosstalk between IAA and JA in the framework of stress responses of roots
CBGP
UPM-INIA
Stress stimulus, e.g. nematodes
JA
IAA
?
ET
Secondary growth?
DZ
EZ
growth
BM
AM
100 µm
Epidermis
Cortex
Endodermis
Pericycle
Quiescent center
Columella
Lateral root cap
Stele
YUC9
20 µM MeJA
Col-0
yuc8
yuc9
yuc8/yuc9
coi1
YUC8/9-dependent
non-YUC8/9-dependent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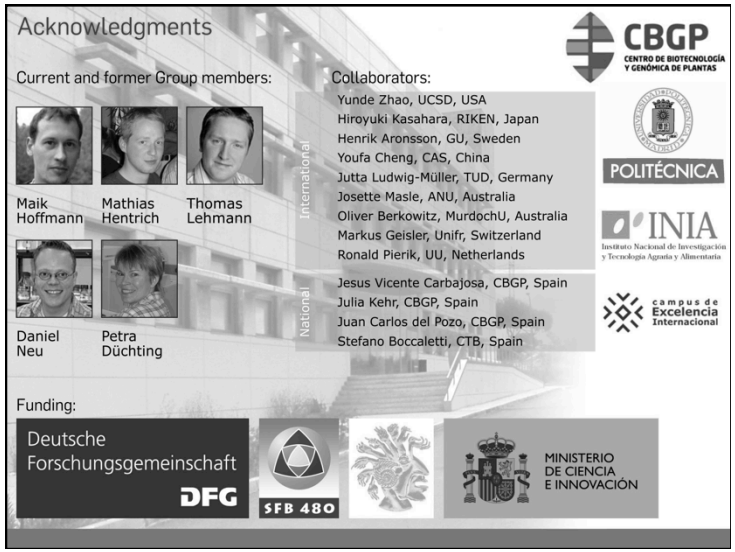
100 µm
YUC9
20 µM MeJA
Col-0
yuc8
yuc9
yuc8/yuc9
coi1
YUC8/9-dependent
non-YUC8/9-dependent
pos.
neg.
Root
Shoot
IAA [M]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